THE GENERAL BOARD

United States Forces, European Theater

REPORT

ON

STUDY OF FIELD ARTILLERY MATERIEL

MISSION: Prepare Report and Recommendations on Field Artillery Materiel, Exclusive of Items Peculiar to Field Artillery Observation Battalions, to Air Observation Sections, and to Communication Sections.

The General Board was established by General Orders 128, Headquarters European Theater of Operations, US Army, dated 17 June 1945 as amended by General Orders 182, dated 7 August 1945 and General Orders 312 dated 20 November 1945, Headquarters United States Forces, European Theater, to prepare a factual analysis of the strategy, tactics, and administration employed by the United States Forces in the European Theater.

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TABLE OF CONTENTS

THE GENERAL BOARD
UNITED STATES FORCES, EUROPEAN THEATER
APO 408

STUDY OF FIELD ARTILLERY MATERIEL

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THE GENERAL BOARD
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APO 408

STUDY OF FIELD ARTILLERY MATERIEL

CHAPTER 1

GENERAL

SECTION 1

PURPOSE AND SCOPE

1. Purpose. The purpose of this study is to analyze and make recommendations on Field Artillery materiel, exclusive of items peculiar to Field Artillery Observation battalions, to Air Observation sections, and to Communications sections.

2. The scope of the study includes consideration of the following:

a. Field Artillery Weapons.

Effectiveness of and necessity for each type.

Experience data on durability, mobility and maintenance.

Desirable calibers.

Types to be towed and types to be self-propelled.

Types to be truck drawn and types to be tractor drawn.

b. Field Artillery Ammunition.

Effectiveness of and necessity for each type.

Results of variations in ammunition lots.

Future requirements for fuzes, projectiles and propelling charges.

c. Field Artillery Fire Direction and Fire Control Equipment.

Efficiency of plotting and calculating equipment.

Field expedients to facilitate fire direction.

Evaluation of both off and on carriage fire control equipment.

d. Miscellaneous Field Artillery Equipment.

Transportation other than ammunition carrying vehicles and prime movers.

Tentage.

Tools and spare parts.

Small arms.

Individual equipment, including clothing.

Lighting equipment.

SECTION 2

PREVIOUS STUDIES

3. The War Department in August 1944 directed the Commanding General of the Army Ground Forces to institute a "Study of weapons and their related prime movers and transport vehicles required for use in the Post War Army". In accordance with the War Department directive the Commanding General Army Ground Forces required each of the various training and development agencies under his control to prepare a detailed study of the materiel and equipment peculiar to its individual sphere of activity. These studies were presented to a Board of Officers appointed by the Commanding General Army Ground Forces. This Board also interviewed individual officers, technicians, and scientists. As a result of five months' study a Preliminary Report was prepared and a General Officer member of the Board, by order of the Chief of Staff United States Army, carried a copy to each theater. The scope of the report is much broader than the original directive and outlines a doctrine of development and covers in detail not only "weapons and their related prime movers and transport vehicles" but includes detailed study of clothing, individual equipment, organizational equipment and communications.

4. Comments of the European Theater. The European Theater instituted a procedure whereby the report was studied by representative groups in all the Armies and their comments consolidated in a preliminary study. This study was reviewed personally by General Eisenhower who approved it with certain exceptions and directed that the detailed final comments reflect certain general features. The final comments of the theater were forwarded to the Chief of Staff by cover letter, Headquarters European Theater of Operations, file Number AG 475 OpGC, dated 27 June 1945.

5. From the Field Artillery point of view the Army Ground Forces Report is thoroughly inclusive. It was studied by a widely representative group of combat experienced field artillery officers and from the materiel point of view the comments on this report constitute almost the only written record of Field Artillery Materiel.

CHAPTER 2

FIELD ARTILLERY WEAPONS

SECTION 1

EQUIPMENT

6. General. In this discussion the term "Gun", "Howitzer", etc., includes its recoil mechanism and the carriage on which it is mounted.

7. Guns. Four guns were used in this theater, viz., the 4.5-inch M1, the 155mm M1 and the 1918 GPF (M12), and the 8-inch M1.

a. It was the concensus of opinion of the artillery officers in the theater that the 4.5-inch gun was unsuccessful and recommendation for its discontinuance was made to the War Department on 26 March 1945.

b. The 155mm guns M1 and 1918 (M12) were successful. The caliber was satisfactory.

c. The large dispersion of the 8-inch gun, the difficulty of adjustment, and its short life were the cause of adverse comment. It was generally considered suitable only for long range harassing fire ("a political weapon"). The necessity for such a weapon was questioned.

8. Howitzers. The following howitzers were employed by the field artillery in this theater:

75mm Pack M1 on carriage M8.

105mm M2 and M3.

155mm M1.

8-inch M1.

240mm M1.

a. All were considered to be successful. The outstanding weapon was the 8-inch howitzer M1. It was generally praised due to its mobility, accuracy and the effectiveness of its projectile.

b. The 75mm Pack M1 and the 105mm M3 employed in the airborne divisions were useful and successful. Their overall effectiveness was limited by their short range which necessitated more frequent displacement than other weapons.

c. The 105mm M2 and the 155mm M1 were universally successful. Used both as organic division weapons and in a reinforcing role they proved to be flexible and effective. The opinion that the 105mm caliber could be replaced by the 155mm for close support of the infantry was expressed, but the opinion was not general.

d. The great difficulty in keeping the 155mm howitzer in action during wet weather due to the inadequacy of the trail and float areas was considered a defect.

e. Bending of the spade and necessity of increased spade and float areas on the 105mm howitzer were reported.

f. The 240mm M1 was universally considered to be a successful weapon because of its accuracy and the effectiveness of its projectile.

9. Mortars. The field artillery in this theater was not armed with mortars. In some corps the Corps Artillery Commander was charged with the training of the 4.2-inch Chemical Mortar Battalion assigned to the Corps. Many 4.2-inch Chemical Mortar Battalion Commanders trained their units in the artillery methods of conducting fire and massing fires and some instances of successful employment were reported. None of the development type mortars were employed in this theater.

10. Rockets. Only two instances of the use of rockets in combat are of record. They were employed in mass for the purpose of delivering preparation fires for an infantry attack. While, in the instances recorded, the fire was successful the opinion was expressed that the short range, wide dispersion, tendency to excessively short rounds, unreliability of the firing mechanisms, and telltale blast in firing made general employment of the rockets impracticable. No opinion has been expressed that the development should be discontinued.

11. Mechanical Failures.

a. The number of weapons out of action due to mechanical failure was largely minimized by the excellent support provided by the mobile Ordnance Maintenance Units. Their support was materially hampered due to lack of parts but in no instance was the situation critical due to mechanical failure.

b. The nature of the more characteristic failures of weapons is covered in detail in the Performance Report, Ordnance Materiel in the European Theater, Office of the Theater Chief Ordnance Officer, Theater Service Forces European Theater, Technical Division, dated 15 August 1945.

c. The problem of tube wear is discussed in Theater General Board Study No 98 "Condemnation and Replacement of Artillery Tubes in Combat".

12. General Comments. It was the general opinion that the flexibility provided through the balance of weight of carriage, traverse of the piece and range provided a satisfactory family of weapons. Many officers desired increase of range but were unwilling to sacrifice accuracy or to accept additional weight of carriage to obtain it. All around traverse was generally regarded as non-essential and some officers stated that it would be a detriment.

SECTION 2

METHOD OF TRANSPORT

13. General. Exclusive of the Airborne Artillery, the artillery used in this theater was both towed, by truck or tractor, and self-propelled.

14. Evaluation of Methods.

a. Opinion among field artillery commanders was almost unanimous that artillery in support of armor must be self-propelled. A self-propelled 155mm howitzer for employment with armored divisions was desired.

b. The majority felt that the 105mm battalions in the infantry divisions should be truck drawn and the 155mm battalions tractor drawn.

c. It was unanimously agreed that a portion of the non-division battalions should be self-propelled. This opinion is reflected in Theater General Board Study No 59 "Organization and Equipment of Field Artillery Units".

e. Both tractor-drawn and truck-drawn artillery was successfully employed in support of both infantry and armored divisions. During the winter of 1944-45 when the roads were covered with ice and during strategic displacements the truck-drawn units were more successful than either tractor-drawn or self-propelled units. The main drawback to mobility under adverse terrain conditions was a lack of flotation of the weapon rather than limitations of the prime mover.

CHAPTER 3

FIELD ARTILLERY AMMUNITION

SECTION 1

GENERAL

15. Effectiveness. Based upon the comments of Prisoners of War the United States Army field artillery ammunition was very effective. Among artillery commanders, except for the clamor against short supply, adverse criticisms are few.

16. Ammunition Supply. The problems of ammunition supply are discussed in Theater General Board Study No 58 "Ammunition Supply for Field Artillery".

17. Ammunition Lots. The main and general complaint of Artillery Commanders was concerned with the mixing of lots of ammunition. Based upon their prior experience, commanders realized that excessively large dispersion of rounds occurred in the firing of mixed lots of powder. This dispersion was of peculiar concern to those commanders charged with the delivery of close-in supporting fires and was particularly objectionable in the 105mm howitzer. Prior to D-Day efforts were made to segregate

and classify the 105mm howitzer ammunition accumulated in the United Kingdom. Mixing of the different classes in the course of transportation to the continent nullified the work which had been done.

18. Special Types. The following special types of ammunition were fired by the Field Artillery: Smoke, both White Phosphorous and Base Ejection; Armore Piercing, both capped and HEAT (High Explosive Anti-tank) and High Explosive with the Concrete Piercing fuze (T105).

a. White Phosphorous was considered useful as an anti-porsonnel projectile both because of its physical and morale effect. Its tendency to pillar reduced its effectiveness as a screening agent but it was useful in locating the point of impact at long ranges and in wooded areas when the smoke from high explosive was difficult to observe. The characteristic burst was also useful in indicating targets to supporting air units. The incendiary qualities of the ammunition was exploited fully but many officers stated that a better incendiary round was needed. The difference in ballistic qualities between it and high explosive caused no appreciable difficulty in either fire direction or conduct of fire.

b. Base Ejection Smoke both Hexachlorethamezine and Colored were used. The screening qualities of the Hexachlorethame-zine were considered excellent and of the colored smokes, red was considered the most useful because of its visibility. The main drawback to the employment of base ejection ammunition was the limitation imposed by the 25 second time fuze (effective range approximately 6700 yards).

c. The armor piercing projectile M112 developed for use by the Coast Artillery was employed in limited quantity by the 155mm gun self-propelled units. While the ability to penetrate concrete was well demonstrated the occurance of a high percentage of duds caused the units to lose confidence in the projectile, and they relied on the high explosive shell with the concrete piercing fuze for the destruction of defensive works. This latter gave very satisfactory results. It was used rather extensively in the battle for Brest, France, (8-inch howitzer 2.5%; 8-inch gun 6.2%; 240mm howitzer 8.1%) and in January of 1945 it was used in large quantities (approximately 5500 rounds) in the 155mm howitzer M1 during the attacks against the Siegfried switch line of the Saar-Moselle triangle. It was not effective in the 155mm howitzer except against masonry buildings.

d. The High Explosive Antitank (HEAT) projectile was effective against armor. It was criticized because of its low velocity and lack of tracer element. It was used in limited quantity (2700 rounds by the artillery of the 12th Army Group).

19. Ballistic Non-Uniformity. The ballistic differences between smoke and high explosive ammunition and

between Pozit fuzed and percussion fuzed rounds of high explosive ammunition caused no serious trouble. Units, individually, devised fire direction center techniques which took the differences into account. However, it was felt that the chance of mistakes would be reduced if all types of ammunition for a weapon possess the same ballistic characteristics.

SECTION 2

FUZES

20. Impact Fuzes.

a. Some commanders reported that a large number of duds occurred when firing the M48 and M51 fuzes. These statements were confirmed by prisoners of war reports. Exploitation of the long delay (0.15 second) feature for ricochet fire was extensively tried in this theater but was unsuccessful due to the terrain.

b. Reports from observers who examined shell craters and observed bursting projectiles indicates that the superquick element of these fuzes as well as that of the M54 and M55 was too slow and that the effect of a burst was more upward than lateral.

21. Time Fuzes. The efficacy of time fire was universally praised by field artillerymen.

a. The time feature of the M54 and M55 fuzes was considered highly accurate but a definite need existed for an equally accurate but longer time train in order to deliver time fire throughout the range of the weapons.

b. The M67 fuze was not sufficiently accurate in its time of functioning for the delivery of efficient time fire and its lack of an impact element was a definite defect.

c. The Pozit fuze was enthusiastically praised as a real advance in materiel design. However, considerable concern was expressed because of increased danger in the operation of the Air Observation Post, and resulted in extensive administrative procedures to clear friendly planes from the area of the trajectory when it was desired to employ the fuze. This resulted in restricting the use of the fuze during daylight. Prisoners of War reports emphasized its effectiveness. The lack of an impact element was a defect.

SECTION 3

PROPELLANTS

22. Zoning.

a. Only partial records were available to study and analyze the necessity for the number of zones and type of powder provided for the howitzers of the American Army. The terrain and tactical situations in the Armies varied. The problem is further complicated

by the fact that supply was short of need. All the ammunition that was available was firdd. The last factor makes analysis of the relative requirement of green bag and white bag powder impracticable. However, comments of experienced officers indicate that the solution offered in the M4A1 charge (Zones 3, 4, 5, 6, and 7), due to simplification of supply, was satisfactory in spite of the relative inaccuracy of the lower zones as compared to the green bag powder.

TABLES OF EXPENDITURE OF AMMUNITION BY CHARGE

WEAPON	ROUNDS CONSIDERED THEATER EXPENDITURES	PERCENTAGE IN ZONES						
		1	2	3	4	5	6	7
105 How M2	2%	0.5	0.7	3.2	10.2	24.4	13.3	47.7
155 How M1	15%	.01	.09	1.0	2.7	28.4	20.3	47.5
8-in How	14%	0.1	0.1	1.5	2.0	24.6	22.4	59.3
240 How	8.8 %	0.2	19.1	39.1	41.6			
155 Gun	10%	45.6	54.4					

b. The above table indicates that it is worth while to produce the powder for the 155mm Gun in the base and increment design and that the necessity for the large number of zones now provided for our howitzers should be reviewed. A reduction in the number of zones may greatl simplify the entire powder problem.

23. Flash and Smoke. There was universal complaint against the flashing characteristic of our propellants and the production of objectionable quantities of smoke during firing. Except for self-propelled weapons the enemy artillery was noticeably free from these features.

CHAPTER 4

FIRE DIRECTION AND FIRE CONTROL EQUIPMENT

SECTION 1

FIRE DIRECTION EQUIPMENT

24. The equipment developed for fire direction in the field artillery proved in general to be of suitable design for combat.

a. The equipment was originally produced for the scale of 1/20,000 whereas the scale used in this theater was 1/25,000. Grid sheets, plotting scales and range deflection fans were procured in England due to short supply from the United States, but proved to be of inferior quality. Graphical Firing Tables were slow in supply and many units constructed their own with consequent inaccuracies.

b. Special calculating devices were lacking, for example, angle of site slide rule and meteorological slide rule. A better grid sheet, more accurately ruled and not sensitive to atmospheric changes, was uniformly demanded. Insufficient provision was made for the

equipment needed in the fire direction centers of long range artillery.

c. It was reported that the protractors and range deflection fans were inaccurate. Equipment which mechanically computes the essential data and designed to minimize human error was universally desired.

SECTION 2

FIRE CONTROL EQUIPMENT

25. On carriage fire control instruments were considered satisfactory optically.

a. Considerable difficulty was experienced with fogging and the various adjusting devices were reported to be too easily loosened during firing.

b. The method of graduation of the azimuth scale was faulty making both reading and setting difficult and liable to mistake. This was considered a definite defect. No need occurred for the range drums or the elbow telescope on the 105mm howitzer either towed or self-propelled.

c. It was the general opinion that a means should be provided on all weapons for setting angle of site independently of elevation for range.

d. Considerable trouble was experienced in keeping on carriage night lighting equipment in operation and a definite requirement existed for an aiming post night lighting device operable from the position of the gun.

e. Telescopes, Observation M49 and BC M65 gave satisfactory service. The range finder was infrequently used in this theater. The M1 model was unreliable and inspection of the highly accurate maps available were considered a satisfactory method of range measurement. A highly accurate range finder is a necessity particularly for use with high velocity direct fire guns.

f. Detailed analysis of characteristic failures of fire control instrument is contained in Performance Report, United States Ordnance Materiel in the European Theater, Office of the Theater Chief Ordnance Officer, Theater Special Forces European Theater, Technical Division, dated 15 August 1945.

g. The meteorological equipment furnished was unsatisfactory in that it was restricted by visibility to an average of a line three message. The later model (SCR 658 radar type) was not made available in time for combat use.

h. A considerable difference of opinion existed as to the accuracy necessary in the instruments provided for survey in the various echelons charged with this function. A resultant error in final location not greater

than 10 yards is considered to be a satisfactory criterion. For a discussion of the degree of accuracy required in survey instruments for observation battalions see Theater General Board Study No 62 "The Field Artillery Observation Battalion".

CHAPTER 5

MISCELLANEOUS EQUIPMENT

SECTION 1

INDIVIDUAL EQUIPMENT

26. Specialized individual equipment peculiar to the arm is not required. Field artillery troops wear the clothing of the supported troops. Where the tactical disposition of an individual, for example a liaison pilot or forward observer, requires special items of clothing or equipment the requirement should be covered by appropriate remarks in Tables of Organization and Equipment. The clothing and equipment furnished in this theater was considered adequate as to type. Supply was short on many items particularly during the winter of 1944-45.

SECTION 2

ORGANIZATIONAL EQUIPMENT

27. Individual Arms. The .45 caliber automatic pistol proved to be satisfactory. Most officers objected to the method of carrying it and obtained shoulder holsters. The carbine was widely criticized because the safety and magazine release were so close together that in moments of excitement men released the magazine instead of the safety. This feature of design was considered a defect. The lack of automatic fire was not considered a defect of design.

28. Tentage. Field artillery units were issued, in addition to shelter halves, the small wall tent, tent fly large and command post tents. The shelter half was not waterproof and the method of fastening the halves together was considered unsatisfactory. The other tentage furnished was insufficient and the deficiency was overcome by occupying buildings for command posts and sheds or buildings for kitchens.

a. There existed a need for better tentage for command posts than that provided. The standard units were inadequate for the drafting and map work required in a field artillery headquarters with the exception of the firing battery which was not provided any. Multiple erection did not solve the problem. Units made them serve but the cramped quarters seriously handicapped accuracy.

29. Lighting Equipment. There was a universal dissatisfaction with the lighting equipment furnished for command post use. The Theater Commander authorized the issue of gas-electric light plants of various sorts which

happened to be available. For the most part the requirement for light overloaded the gasoline engines and combined with constant running made maintenance a continual burden and was the cause of inopportune breakdown. It was not until units had captured German mobile plants designed for heavy duty continuous operation that the deficiency was overcome.

30. Map Case. The Case, Canvas, Dispatch was considered to be an unsatisfactory item of equipment. There was procured in the Theater, a issued locally, a British type map case which was considered to be a superior article. It was issued in only one size (approximately 12 inches x 16 inches). This size is unsuitable for forward observers and the opinion was expressed that an additional case about 6-1/2 inches x 9-1/2 inches is required.

SECTION 3

TRANSPORTATION

32. General. The general purpose vehicles provided for use in Field Artillery units gave satisfactory service. The 3/4-ton command car was widely criticized because of riding discomfort. The 3/4-ton weapons carrier was considered inadequate for use as a radio truck and battery motor mechanics truck. Neither was suitable for reconnaissance. These complaints are reflected in the Theater General Board Study No 59 "Organization and Equipment of Field Artillery". Short supply of parts was widely decried.

33. Types. In the theater comments on the Army Ground Forces Equipment Review Board Report it is noted that recommendation was made to eliminate the 1-1/2-ton vehicle as a type and to substitute the 3/4-ton vehicle therefore. Analysis of the comments of the Armies and the recommendations submitted pertaining to Tables of Organization and Equipment lead to the opinion that the group of officers who prepared the theater recommendations either misconstrued the recommendations or that a typographical error was made in preparation of the comments. The opinion in this theater is that both the 3/4-ton and 1-1/2-ton types are needed for efficient organization. The 3/4-ton vehicle is inadequate for unit motor maintenance and radio vehicles and the 2-1/2 ton truck is an uneconomical substitute.

34. Tools. The tools issued for the maintenance of transportation were generally considered to be adequate and satisfactory. The box type voltage tester was too complicated and required too much training for efficient Second Echelon use. All agree that a gear puller should be included in the Second Echelon tool set.

a. The following items were considered non-essential:

(1) Second Echelon tool set No 4.

(2) Holmes Anchor Set.

(1) Safety can, 5 gallons.

b. The wheelbarrow type air compressor was inadequate in capacity and ruggedness.

35. Mechanical Failures and Design Defects. The characteristic mechanical failures and design defects of the various types of transportation are described in detail in the Performance Report, United States Ordnance Materiel in the European Theater, Office of the Theater Chief Ordnance Officer, Theater Service Forces European Theater, Technical Division, dated 15 August 1945.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

SECTION 1

CONCLUSIONS

36. It is concluded:

a. That in general the materiel furnished the field artillery in this theater was adequate in quality.

b. That the proposals of the Army Ground Force Equipment Review Board Report as amended by letter, Headquarters European Theater of Operations, dated 7 June 1945, file 475 OpGC, Subject: "Army Ground Force, Equipment Review Board, Preliminary Study", expresses the opinions of field artillery officers in this theater both as to the improvements needed in current standard materiel and as to the scope of field artillery development in the post war period.

c. That study of the technique of fire direction is needed with a view to producing an accurately gridded plotting surface insensitive to weather, improved plotting and measuring equipment and mechanical calculating equipment designed to minimize human mistakes.

d. That the tentage and lighting equipment furnished was inadequate for the type of work carried on in field artillery command posts.

SECTION 2

RECOMMENDATIONS

37. It is recommended:

a. That the defects in design of current standard materiel be immediately corrected unless such correction would necessitate complete redesign of the equipment in question.

b. That the field artillery program of development as outlined in the Army Ground Forces Equipment Review Board as amended by letter, Headquarters European Theater of Operations, dated 7 June 1945, file 475 OpGC,

Subject: "Army Ground Force, Equipment Review Board, Preliminary Study", report be actively pursued.

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